TRANSLATOR'S CERTIFICATE

I, Daniel Cooper, residing at 1310 Felicity Street, New Orleans, Louisiana 70130, declare:

That I am thoroughly conversant with the German and English languages;

That I have carefully made the attached translation from the original document, written in the German language;

That the attached translation is a true and correct English version of such original, to the best of my knowledge and belief;

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the patent or trademark.

Daniel Cooper

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Federal Republic of Germany
German Patent and Trademark Office

DE 103 59 239 A1 7/7/2005

Laid Open Application

Title: Method for Displaying a Fixation Mark for Ophthalmological Therapeutic Equipment

Abstract: The present invention is directed to a fixation mark which is to be displayed to the patient in order to prevent unwanted eye movements during the treatment of an eye without taxing the patient's ability to concentrate. In the method according to the invention, the fixation mark which is to be displayed and to which the patient must orient the eye to be treated by foveal focusing is projected in the field of vision of the eye to be treated. To prevent unwanted eye movements, the fixation mark is moved in the field of vision of the patient. The movement is carried out in such a way that the patient can easily follow the fixation mark. The proposed technical solution relates to a fixation object which can be used in ophthalmological examination devices as well as in ophthalmological treatment devices. Since the patient is occupied in following the fixation object with his/her eyes, the risk of glancing away is substantially reduced. In this way, unwanted and uncontrolled movements of the eye being treated can be minimized.

Description

[0001] The present invention is directed to a fixation mark that is presented to the patient to prevent unwanted eye movements during the treatment of an eye without taxing the patient's ability to concentrate.

[0002] While the use of moving fixation marks in ophthalmological devices is already known, this use is primarily directed to the determination of the visual field by means of perimetric arrangements and not to the suppression of unwanted eye movements while looking at a rigid fixation object during examination or treatment.

Prior Art

[0003] For example, DE 31 43 882 describes a method for ensuring fixation in ophthalmological examination devices, particularly for determining the visual field. For this purpose, a fixation point is projected on a surface located in the viewing direction of the patient and is coupled with a marking point to correlate its relative position with the visual field diagram to be established. The fixation point is periodically moved slowly on a predetermined path so that the patient can easily follow this movement. The path of the fixation point can be, for example, a straight line, an elongated ellipse, or a circular path. Excursion is advantageously +/– 2° in horizontal direction and +/– 0.2° in vertical direction with an excursion rate of about 2° per second. The instantaneous relative position of the fixation point with respect to the test mark can be transferred into the visual field diagram optically and electronically. Depending on the type of perimetric hemisphere that is used, the projection of the fixation point and test mark can be carried out through front projection or back projection.

[0004] A perimeter, particularly a spherical perimeter with a reflex fixation safeguard, is described in DE 41 08 403. In this case also, the visual field is analyzed by means of a fixation mark that is moved periodically relative to the patient. However, the movement is carried out by periodically rotating the perimetric sphere, together with the fixation mark which is rigidly connected to it, around an imaginary vertical axis substantially extending through the eye to be examined. The approximately circular light spots which can be deflected in two angular degrees can be projected on selected positions of the inner surface of

the sphere by known electrically controllable systems. It is not described in detail how the visual field is determined from the results of the examination.

[0005] The solution described in US 4,995,717 is also directed to a device for determining the visual field of a patient. For this purpose, a reference mark is placed in the center of a computer display on which the patient's eye must be fixated. Light marks are then generated successively on the computer display to determine the visual field of the patient. The patient signals, e.g., by actuating a mouse, when he/she can see the light mark as it becomes visible. The visual field and any defects of the eye being examined are determined by evaluating the detected light marks.

[0006] In contrast to the references mentioned thus far, DE 41 08 435 describes an arrangement for monitoring fixation which can preferably likewise be applied for devices for examination of the visual field, but principally also for other ophthalmological examination instruments. Means are provided for rotating a structured fixation mark around a central axis to furnish a functional, reproducible fixation stimulus. The fixation mark has a structure and a predominant direction which can be identified by the test subject only when the test subject has foveal fixation. This is achieved in that the fixation mark is formed, for example, as a Landolt ring which adopts discrete directional orientations when rotated. A Geneva drive generates the discrete directional orientations of the fixation mark from a uniform rotating movement in 90-degree rotations with a stationary interval. The test subject must constantly follow the slit of the Landolt ring during the examination, which can be accomplished only with corresponding foveal fixation.

[0007] The solutions mentioned above are provided predominantly for campimetric examination, i.e., for determining the visual field or defects in the visual field. The fixation marks used in treatment devices are generally stationary. Although laser treatments in ophthalmology last only minutes, unwanted eye movements nevertheless occur when using stationary fixation marks. Also, this cannot be prevented by alternating the type, color and/or intensity of the fixation marks.

Object of the Invention

[0008] It is the object of the present invention to develop a solution which prevents or at least minimizes unwanted movements of an eye to be treated.

[0009] According to the invention, this object is met through the features of the independent claims. Preferred further developments and embodiments are indicated in the dependent claims.

[0010] The proposed technical solution relates to a fixation object which can be used in ophthalmological examination devices as well as in ophthalmological treatment devices. By means of the moving fixation object, the patient orients his/her eye to the fixation object and easily follows it. Since the patient is occupied in following the fixation object with his/her eyes, the risk of glancing away is substantially reduced.

Embodiment Example

[0011] The invention will be described in the following with reference to an embodiment example.

[0012] In the proposed method for displaying a fixation mark for ophthalmological treatment devices, the fixation mark to be displayed is projected in the field of vision of the eye to be treated so that the patient orients the eye to be treated to this fixation mark by foveal focusing. The fixation mark is moved in the field of vision of the patient, and the movement is carried out in such a way that the patient can easily follow the fixation mark. The movement of the fixation mark in the field of vision of the patient is carried out continuously or discontinuously, according to a predetermined sequence, or randomly. In this way, no unwanted eye movements can take place.

[0013] Measurement or therapy can be carried out differently depending on the kind of movement of the fixation mark.

[0014] For example, when the fixation mark is moved discontinuously in the field of vision of the patient, diagnosis or therapy is preferably carried out only within the short stationary phases of the fixation mark. In contrast, when the fixation mark is moved continuously, diagnosis or therapy can also be carried out while the eye follows the movement of the fixation mark.

[0015] The fixation mark can be displayed and moved, for example, on a display or an XY mirror unit. The movement of the diagnostic beam or therapeutic beam should then be carried out by means of the same XY mirror unit or should be corrected by the movement of

the fixation mark. For this purpose, it is advantageous when the movement of the fixation mark is carried out according to a predetermined sequence. A predetermined movement sequence can also be dynamically structured in a subjective manner for the patient so that there is no fatigue effect.

[0016] In principle, it is also possible to move the fixation mark randomly in the field of vision of the patient. In this case, for exact positioning and tracking of the diagnostic beam and therapeutic beam it is absolutely necessary to acquire the position of the fixation mark online, e.g., by means of an eye tracker, and to take into account the movement of the diagnostic beam or therapeutic beam simultaneously.

[0017] In another embodiment, the movement of the fixation mark can also be used to position the eye in a specific manner. The diagnostic beam or therapeutic beam remains rigid; the beam is positioned on the eye through the eye movement. For this purpose, it is necessary that the eye movement can follow the moving fixation mark.

[0018] By means of the method according to the invention for displaying a fixation mark for ophthalmological treatment devices, it can be ensured that unwanted and uncontrolled movements of the eye being treated do not occur during the treatment.

Patent Claims

1. Method for displaying a fixation mark for ophthalmological treatment devices in which the fixation mark to be displayed is projected in the field of vision of the eye to be treated, the patient orients the eye to be treated to this fixation mark through foveal fixation, the fixation mark is moved in the field of vision of the patient, wherein the movement is carried out in such a way that the patient can easily follow the fixation mark.

2. Method for displaying a fixation mark according to claim 1, wherein the movement of the fixation mark in the field of vision of the patient is carried out continuously or discontinuously, according to a predetermined sequence, or randomly.

3. Method for displaying a fixation mark according to at least one of the preceding claims, wherein the fixation mark is moved discontinuously in the field of vision of the patient, and a measurement or therapy is carried out only within the short stationary phases of the fixation mark.

4. Method for displaying a fixation mark according to at least one of the preceding claims, wherein the fixation mark is moved in the field of vision of the patient, and a measurement or therapy is carried out while the eye follows the movement of the fixation mark.

5. Method for displaying a fixation mark according to at least one of the preceding claims, wherein the movement of the fixation mark is used to position the eye in a specific manner.

6. Method for displaying a fixation mark according to at least one of the preceding claims, wherein the movement of the fixation mark is carried out through variable display on a stationary display.

7. Method for displaying a fixation mark according to at least one of the preceding claims, wherein the movement of the fixation mark is carried out by means of an XY mirror unit.

8. Method for displaying a fixation mark according to at least one of the preceding claims, wherein the movement of the fixation mark and of a diagnostic beam or therapeutic beam is carried out by means of the same XY mirror unit.

9. Method for displaying a fixation mark according to at least one of the preceding claims, wherein the movement of a diagnostic beam or therapeutic beam is corrected by the previously determined movement of the fixation mark.

10. Method for displaying a fixation mark according to at least one of the preceding claims, wherein the movement of a diagnostic beam or therapeutic beam is corrected by the movement of the fixation mark which is acquired online.